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CATACEL SSR

Tailored catalyst technology



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Inspiring science, enhancing life

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CATALCEL SSR technology

Introduction

CATALCEL SSR™ is an innovative and industry leading technology that delivers a sharp improvement in the catalyst technology that is available to the operators of steam reforming units. CATALCEL SSR technology allows unique and unexpected combinations of heat transfer properties, reactive surface area and pressure drop characteristics within tubular steam reformers. These enhanced catalyst performance parameters can be tailored and targeted for each steam reforming plant such that maximum operational benefit is released for plant operators or for those designing new steam reforming units. This brochure provides a summary of the engineering and chemistry that underpins **CATALCEL SSR** and offers a perspective on the value that is released by this technology.

Metal foils & catalyst coatings

A number of high quality metal alloys possess the combination of properties that allows them to be formed as thin metal foils and used as carriers for catalysts. In particular, metal foils are light, extremely durable, they are good conductors of heat and they can operate efficiently in very high temperature environments. Furthermore, when these foils are subject to carefully controlled thermal treatments the chemistry of the alloys can be altered such that the surface layers of the foils can act as an outstanding base for the attachment of catalytically active coatings. There are a number of constituents of a catalyst coating that are required to ensure that the binding of the coating to the metal foil is robust and durable. However, the preparation of catalysts by the use of coating technology opens up the possibility of using a range of active catalyst components, stabilisation additives and other promoters that are not always feasible in more traditional catalyst systems.

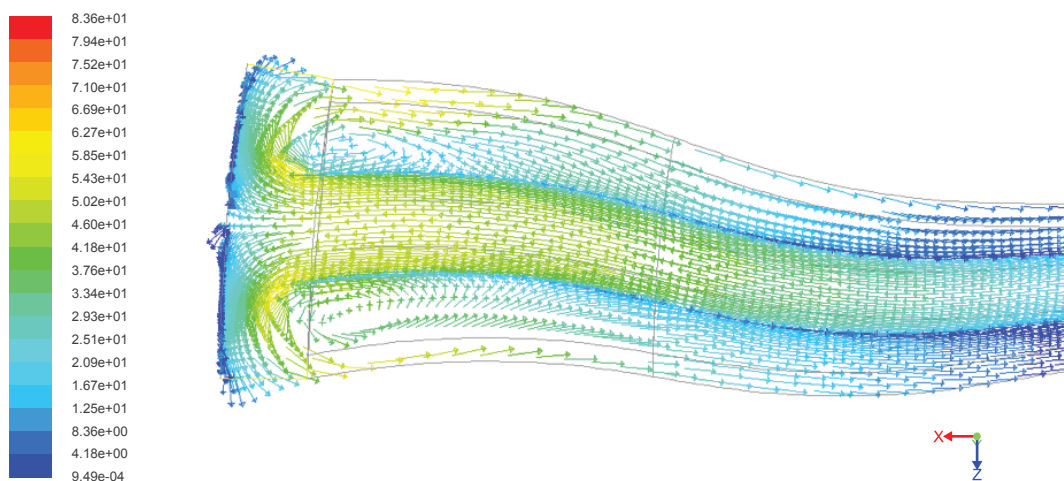
Structured catalysts

A structured catalyst is a system in which the fundamental characteristics of a catalyst coated metal foil are used to design a precision engineered reaction media. The inherent and repeating structure that can be produced in such an engineered system ensures that the reacting gases within a tubular steam reformer are guided in a highly controlled flow path through the steam reforming reactor. This provides reproducibility of behaviour from tube to tube and also allows the designers of these structures to engineer unique features within the structure that deliver high voidage, high geometric surface area and desirable patterns of gas flow.

Key features of CATACEL SSR

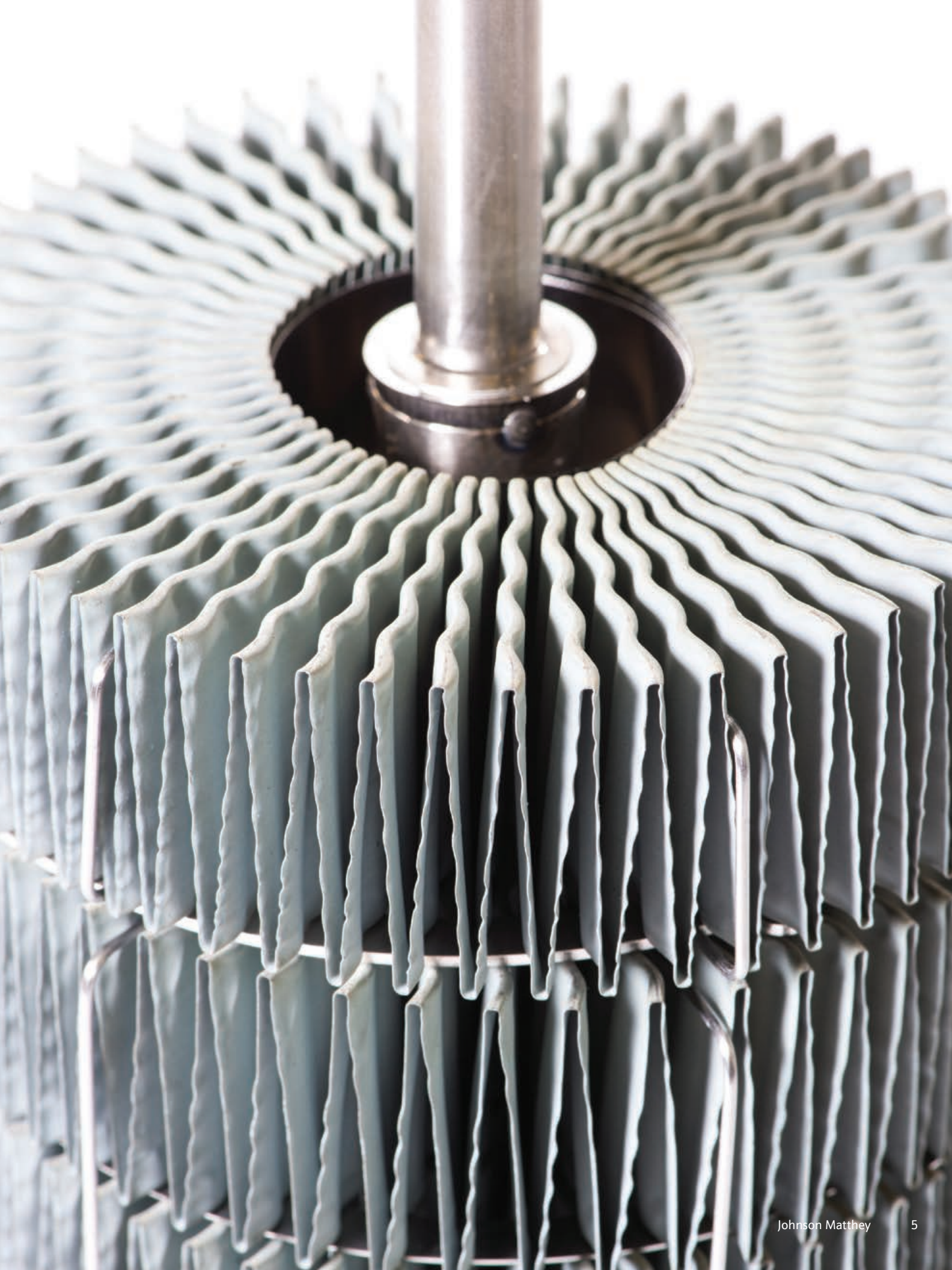
CATACEL SSR is designed to leverage the high voidage, high geometric surface area and controlled gas flow that is available in a structured catalyst system to gain the maximum possible process benefits within the unique environment of a tubular steam reformer. Hence, the low voidage of **CATACEL SSR** provides the operator with an intrinsically low pressure drop reaction media and the high geometric surface area delivers a high activity steam reforming catalyst

However, the outstanding design feature of **CATACEL SSR** is the distinctive "fan" structure that is created by the precise manipulation of the underpinning metal foil. This feature carefully directs the gas flow in and through the **CATACEL SSR** structure and, most importantly, causes radial impingement of the gas onto the internal wall of the reformer tube. The "jetting" mechanism acts to destroy the stagnant, and heat transfer limiting, gas film that exists on the internal wall structure of the tubular reactors that are used in the steam reforming process. This "jetting" process repeats itself radially around the reformer tube and axially down the tube and it is this innovative behaviour that lifts the heat transfer characteristics of the **CATACEL SSR** technology to unsurpassed levels.



Velocity Vectors Colored by Velocity Magnitude (m/s)

ANSYS Fluent 14.5 (3d, dp, pbns, sstk)

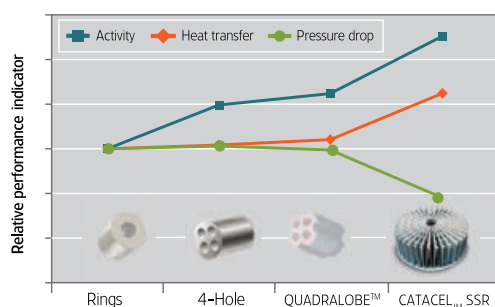


CATACEL SSR

Operational benefits

Best in class heat transfer, pressure drop and catalytic activity

CATACEL SSR technology produces a combination of high heat transfer, low pressure drop and high reactive surface area that cannot be achieved with any other catalyst system that is available in the industry. In this respect **CATACEL SSR** is the best ever catalyst technology that has been manufactured for use in tubular steam reformers. The technology is, within its field, highly disruptive and it will provide unique value and a basis for innovation for all operators and designers of steam reforming process technology.



Design flexibility

Every operating steam reformer is unique in respect of, for example, feed properties, reformer tube length, reformer tube metallurgy, reformer tube internal and external diameters, burner design, fuel composition, furnace size and furnace geometry. In order to optimise the economics of operation in such a system a great deal of design information and process data are required as inputs to complex programmes such as Johnson Matthey's PRIMARY model. To date, suppliers have been able to deliver a limited range of catalysts that provide no more than binary changes in the factors that a process operator or designer can vary within these models when seeking to optimise performance. For example, small pellets have aided enhanced heat transfer but severe penalties are often encountered in respect of pressure drop. In this respect **CATACEL SSR** is a game-changer. The patent-protected fan structure can be designed and manufactured with a range of fan heights, with different densities of folds and with an interesting variety of fine design features. These variables produce an almost infinite combination of heat transfer, pressure drop and reactive surface area combinations that, when integrated with an understanding of the characteristics of each reformer unit, can be altered to maximise value for every reformer and every customer.



Impact on plant operation

CATACEL SSR can deliver substantial benefits for many operators & new plant designers. These include:

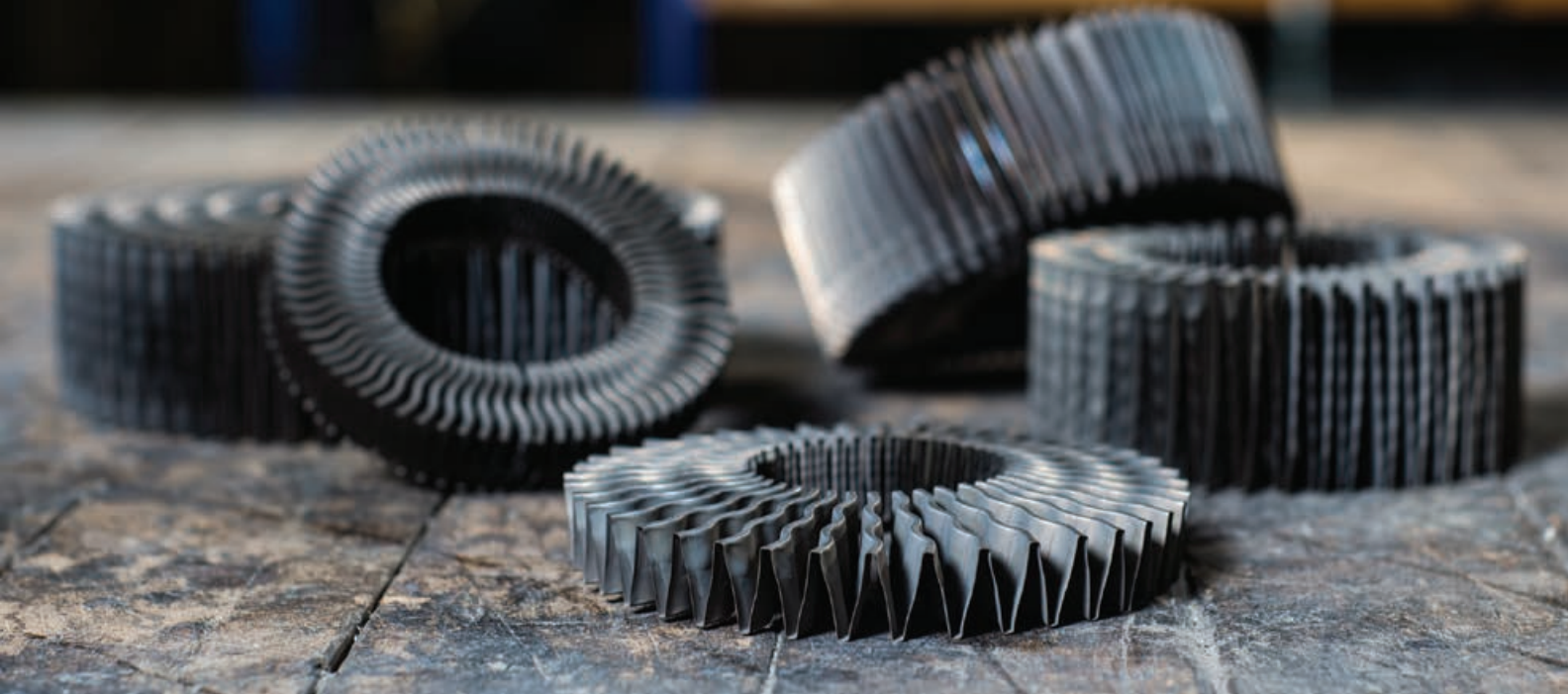
- **Currently Operating Units**
 - Fuel savings
 - Release from TWT or DP limitations
 - Reduction in S/C ratio with no loss in carbon margins
- **Revamps**
 - Plant throughput increases
 - Replacement with thinner tubes
- **New Plants**
 - Smaller, intensified, reformer box design
 - Install in new tubes laying down

CATACEL SSR application

Value creation

The enhanced heat transfer, larger reactive surface area and lower pressure drop characteristics of **CATACEL SSR** can deliver the most value to the operator of a hydrogen or syngas plant where a design or an operating process limit is constraining the efficiency or capacity of operation. It is commonly found that **CATACEL SSR**, unlike traditional pellet catalysts, can release the plant from these constraints. The typical value created by **CATACEL SSR** includes:

- **Currently Operating Units**
 - 1% - 2% throughput increases (at same trim fuel rate) when **CATACEL SSR** used as a direct replacement for standard pellets
 - 2% - 10% trim fuel savings when **CATACEL SSR** is used as a direct replacement for standard pellets
 - 20% decrease in pressure drop compared to standard pellets
 - Steam to Carbon decrease of 0.5 units (mol/mol) when replacing standard non-alkalised pellets
- **Revamps**
 - 10% - 20% throughput increase with no change in tube wall temperature margin
 - Tubes can be changed to lower cost, thinner wall, systems
- **New Plants**
 - Decrease in tube count by 10% - 20%
 - Decrease in tube wall thickness and or longer tubes
 - 5% - 20% lower capital cost of the radiant box



Custom solutions

CATACEL SSR is a bespoke premium product. The product comprises specialized technology that includes a precision designed and manufactured reactor in combination with an exceptional **CATACEL** catalyst coating. The technology delivers unique and differentiated performance.

CATACEL SSR solutions are available for your plant in the following product categories:

- **CATACEL SSR Drop PD**
 - For lower pressure drop
- **CATACEL SSR Ultra HT**
 - For higher heat transfer
- **CATACEL SSR Max GSA**
 - For high activity/high carbon resistance
- **CATACEL SSR Easy Carbon**
 - For improved carbon resistance

Installation

CATACEL SSR is installed into reformer tubes using patent-protected equipment that guides the product to the correct location within the tube and which then facilitates expansion of the technology such that a snug and operationally efficient fit is made to the internal surface of the reformer tube. Removal of the product from the tubes is carried out by using a simple extraction tool which locks on to the **CATACEL SSR** technology and which allows extraction via the inlet of the tube. Both the installation and the extraction tools are available from Johnson Matthey or its licensed contractors. These processes have been proven, in both pilot scale trials and in operating steam reformers, to be simple, fast and effective. However, because each reformer is unique it is important that the detailed design around the reformer header and any constrictions that exist at the entrance to the reformer tube are considered well in advance of any planned installation.

CATACEL SSR Contacts & Support

CATACEL SSR is designed and manufactured at Johnson Matthey's Technology Center in Ravenna Ohio, USA. This facility is dedicated to the design, manufacture and testing of a range of patent protected structured catalyst carriers and a bespoke range of coated catalysts.

CATACEL is marketed and sold throughout every region of the world. Our dedicated teams are available in our offices in Chicago, Illinois; Houston, Texas; Billingham, UK; Vleuten, Holland; Turin, Italy; Moscow, Russia; Kuala Lumpur, Malaysia; Dubai, UAE; and Beijing, China.





For further information on Johnson Matthey, please contact your local sales representative or visit our website.
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